Lessons learned for Monitoring Large Woody Debris Projects

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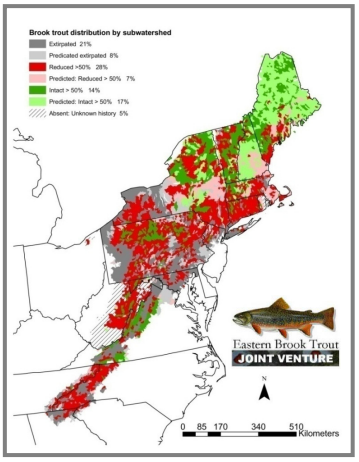
What's the ????

- Ecological processes
- Nutrient storage/uptake
- Fish response
- Safe navigation
- Bank erosion
- Meet DFC's of Plans (Roy)

Importance of Wood

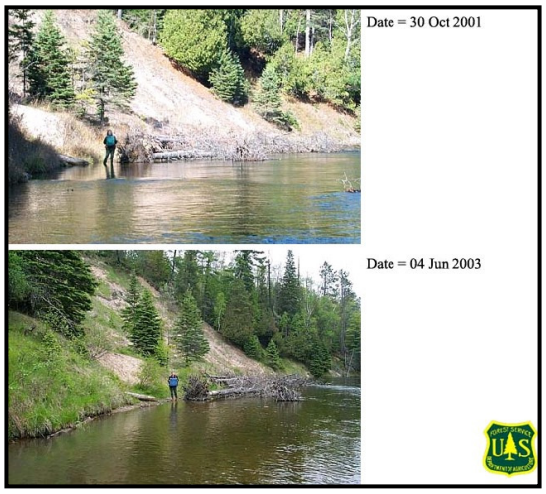


Some Easy

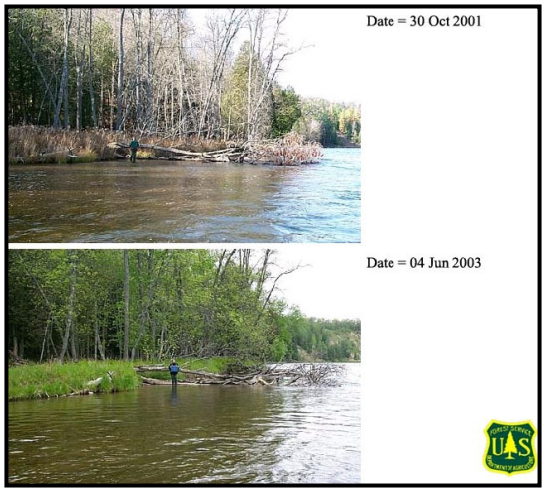
Some hard

Photo Monitoring

Simple

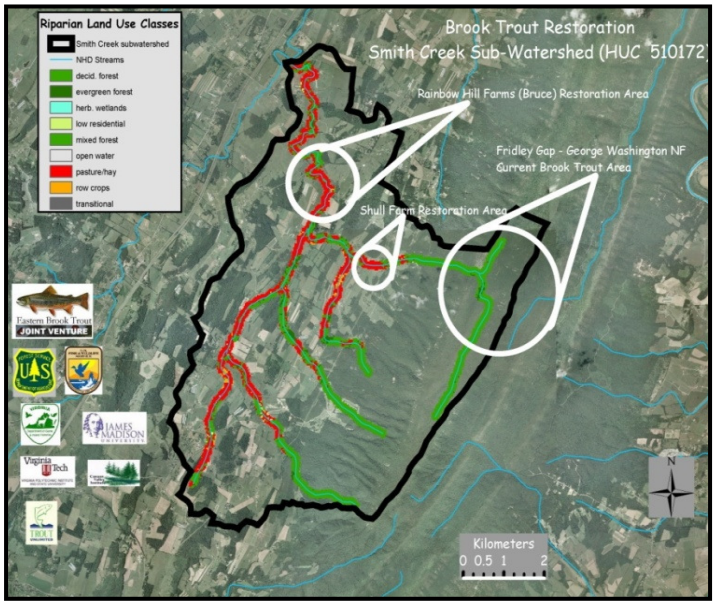


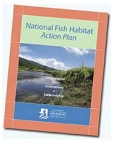
Inexpensive



Effective !


Date = 30 Oct 2001
Date = 04 Jun 2003


Riparian Land Use Classes
Smith Creek subwatershed
NHD Streams
decid. forest
evergreen forest
herb. wetlands
low residential
mixed forest
open water
pasture/hay
row crops
transitional
Brook Trout Restoration
Smith Creek Sub-Watershed (HUC 510172)
Rainbow Hill Farms (Bruce) Restoration Area
Fridley Gap - George Washington NF
Current Brook Trout Area
Shull Farm Restoration Area
Eastern Brook Trout
JOINT VENTURE
Kilometers
0 0.5 1 2


National Fish Habitat
Action Plan

Fridley GAP

Objectives

1. Examine variability of LWD density and distribution in Fridley Run over a 15 year period

2. Look for relationships between LWD and Brook trout number and distribution

3. Comment on factors affecting LWD variability and make suggestions for monitoring and managing LWD in streams

Methods

Fridley Run - LWD Data

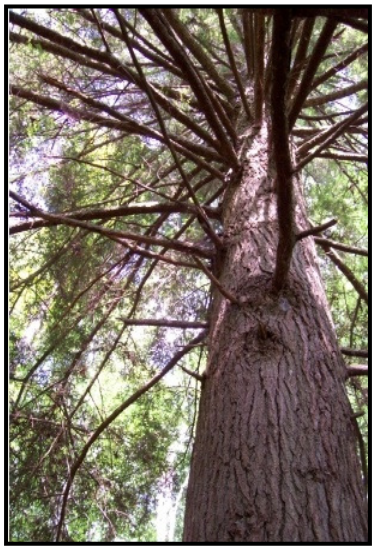
- Basinwide Visual Estimation Technique (BVET) stream inventories (Dolloff et. al 1993)
  - 1994, 2001, 2008
  - Counts of LWD by size class
  - Location of LWD along the length of the stream
  - Also measures stream habitat features that are influenced by LWD
    - Eg. Number and depth of pools

Conducting 2008 BVET inventory

Sources of LWD Variability in Fridley Run

- **Input**
  - Storms
    - Hurricane Fran (1996), Hurricane Isabel (2003) and severe thunderstorms
    - Ice storms
  - Forest pests
    - Gypsy Moth (1990s)
    - Hemlock Wooly Adelgid (2003 –present)
- **Loss**
  - Floods
    - 2006 - 100+ year flood
  - Historic logging
    - 2nd growth forest unlogged since 1950s

Input



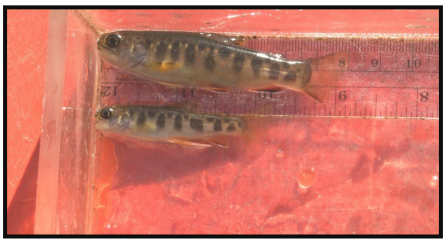
Hemlock mortality caused by Wooly Adelgid

Loss

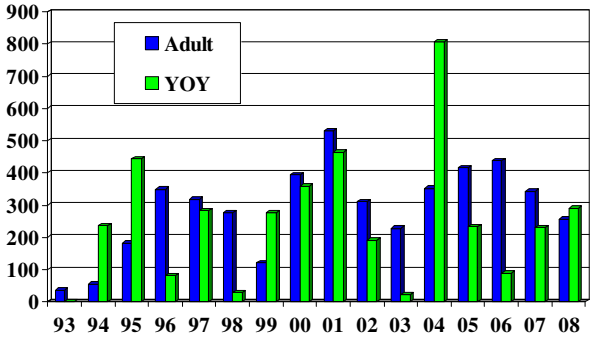
2006 Flood

Electrofishing

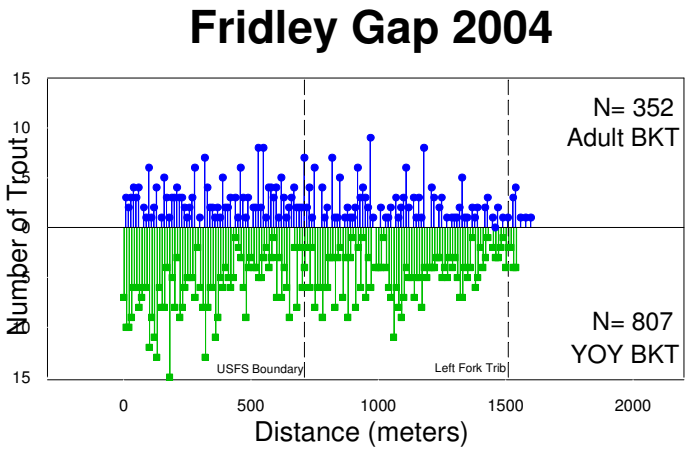
- Sampled annually (15 years) July when yoy brook trout were 50-75mm in length
- Mark-Recapture for the entire 2.2 km



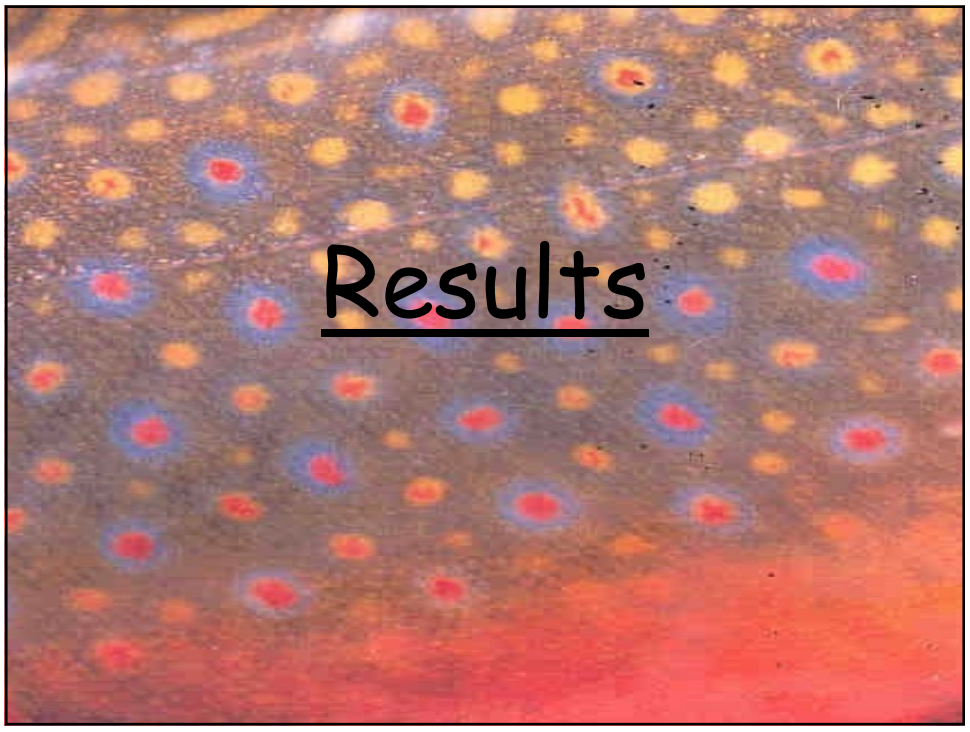
Population of brook trout 1993-2008

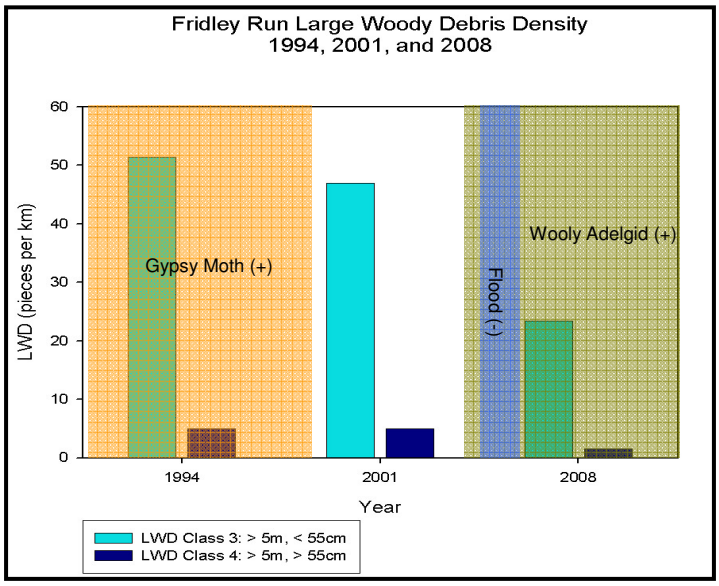


Distribution of Brook Trout



USDA Forest Service Fish and Aquatic Ecology Unit





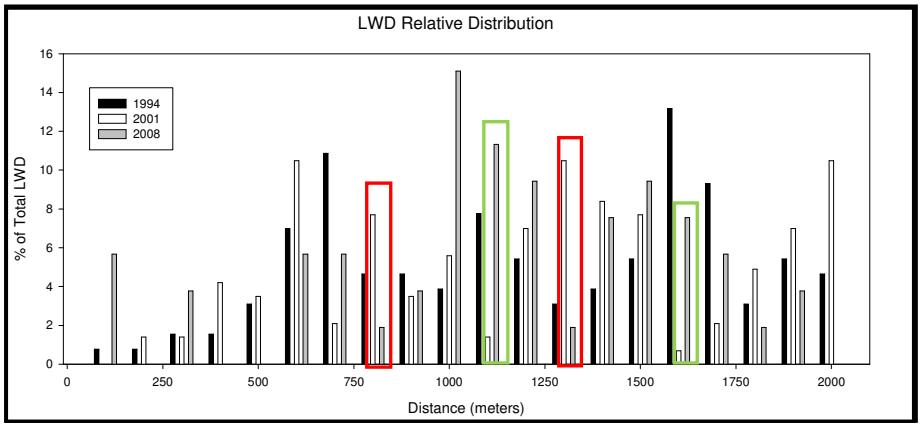
LWD Density

- Very little change in LWD density (pieces per km) from 1994 to 2001
  - 56 (1994) to 52 (2001)
- Density of LWD decreased significantly between 2001 and 2008
  - 52 (2001) to 25 (2008)

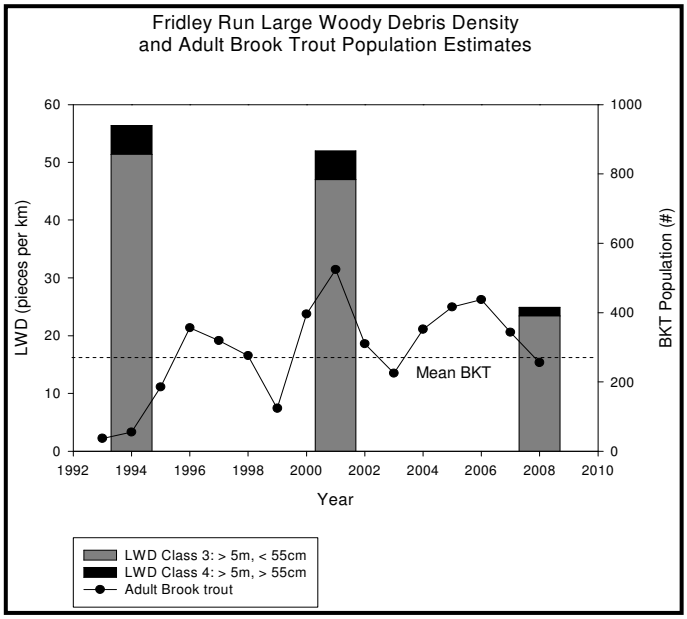
LWD Distribution

- Location of LWD along the length of the stream.
- Used LWD sum of 100m stream reaches
- Kruskal-Wallice one-way ANOVA on ranks
  - Similar from 1994 to 2001; $p > .05$
  - Different from 2001 to 2008; $p < .05$
  - Different 1994 vs 2008; $p < .05$

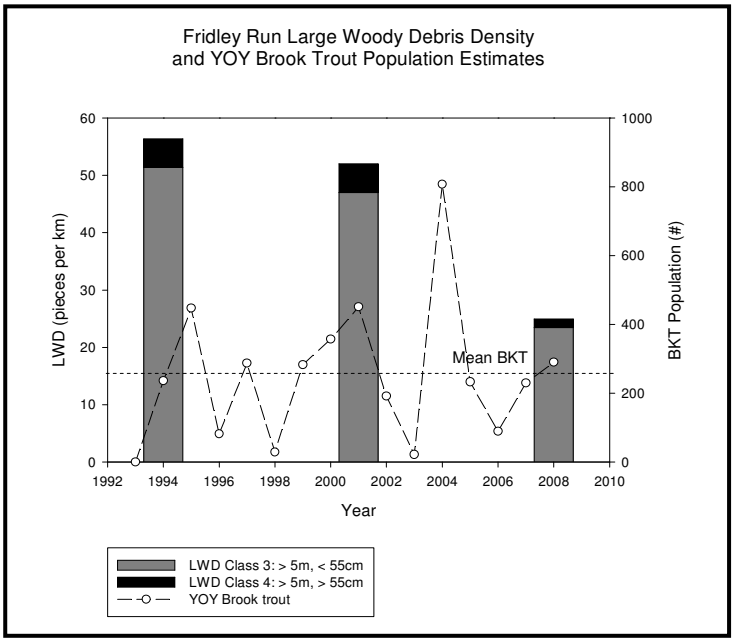
LWD Distribution



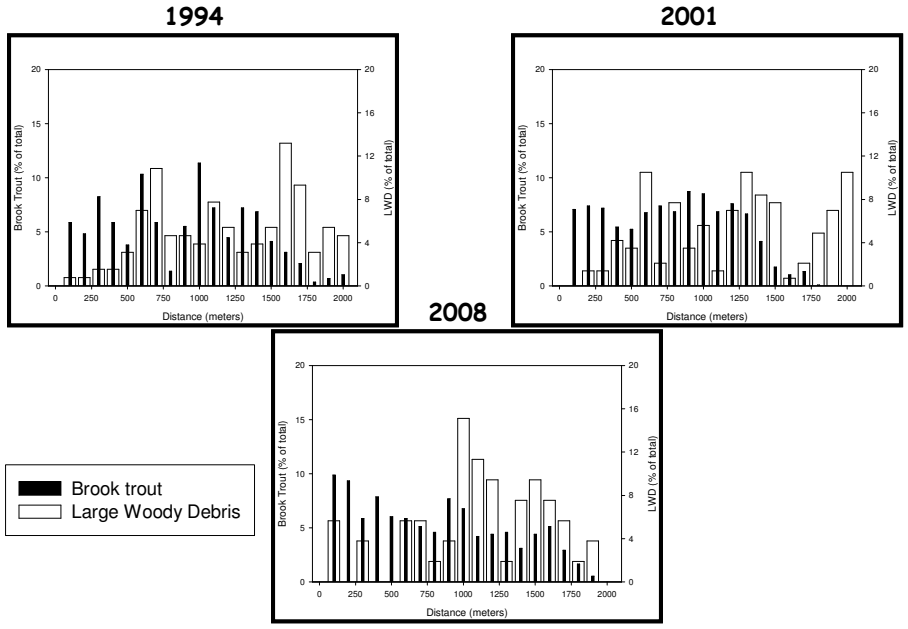
LWD Density and Brook Trout Population



LWD Density and Brook Trout Population



LWD and Brook Trout Relative Distribution

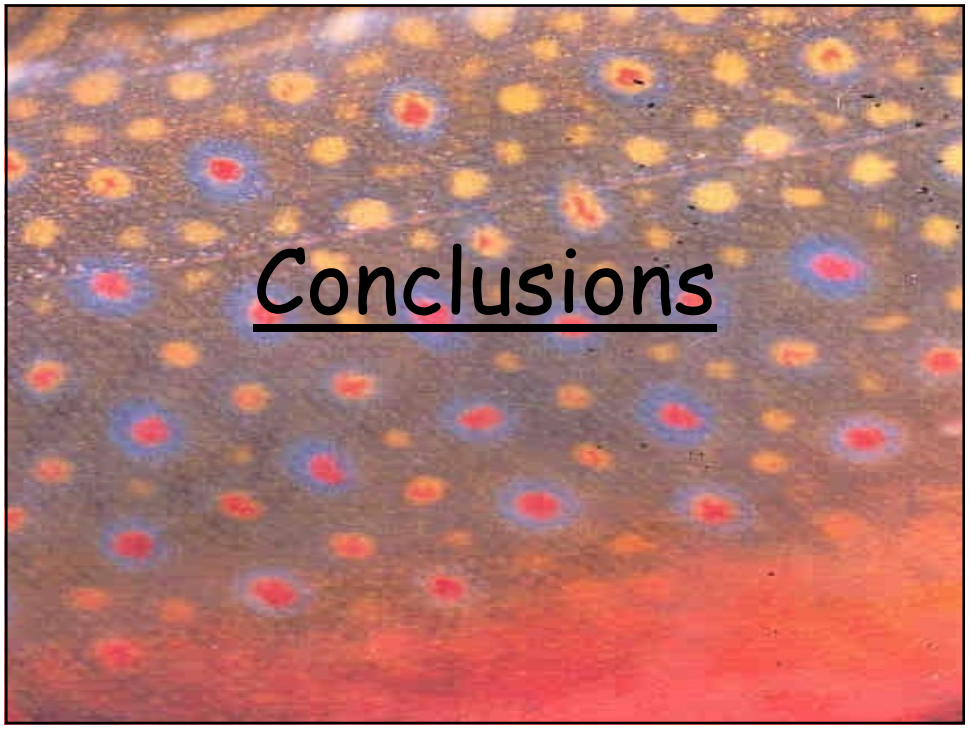


LWD and Brook trout Distribution

- No significant relationship between the distribution of LWD and Brook trout any year
  - Spearmans rank correlation

    P value
    - 1994 - 0.45
    - 2001 - 0.24
    - 2008 - 0.60

- No relationships for adults or young of the year



Conclusions

- LWD Variability
  - Density highly variable
  - Distribution highly variable

- LWD and Brook trout
  - Brook trout populations do not appear to be driven by LWD density
  - Brook trout distribution does not appear related to LWD distribution
  - No relationships for adult or young of the year

Discussion

- Brook trout
  - Greater association with stream physical habitat than LWD itself
    - Pool:Riffle ratio unchanged (33% pools 2001, 34% 2008) over time period when greatest decrease in LWD was observed
    - "Just not wood" Stream physical habitat in Fridley Run more influenced by boulders than LWD

Suggestions for Monitoring and Managing LWD in Streams

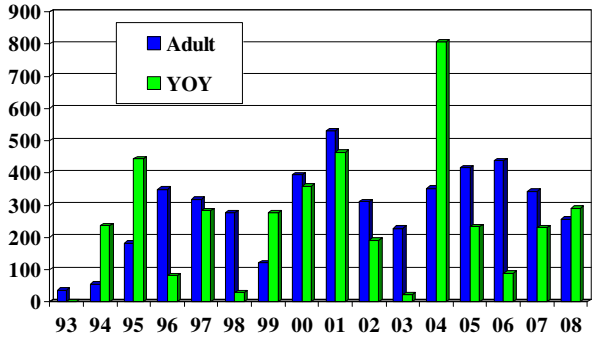
- More frequent inventories
  - If a tree falls in a stream and no one is there to count it, does it make a difference?
- More focused inventories
  - Conduct inventories when and where needed most
    - Streams where LWD has strong influence on fish populations
    - Streams where stream habitat is highly influenced by LWD
    - Streams where changes in LWD recruitment and transport are expected

Difficulties linking LWD Projects and Fish response

- Dynamic systems
  - High variability in wood
  - High variability in fish populations

Poor Statistical Power !

Population of brook trout 1993-2008

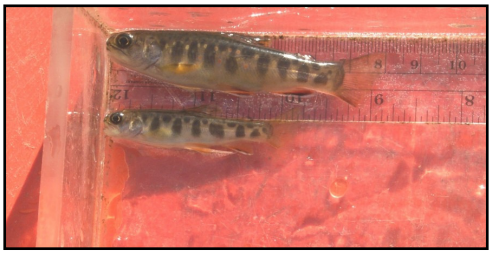


Adult Population (> 100mm)

- Over a 14-year period:
  - Average = 307
  - SD = 126
  - Range = 55 - 524
  - **CV = 41 %**

Young of the Year Population

- Over a 14-year period:
  - Average = 267
  - SD = 208
  - Range = 22 - 809
  - **CV = 78 %**

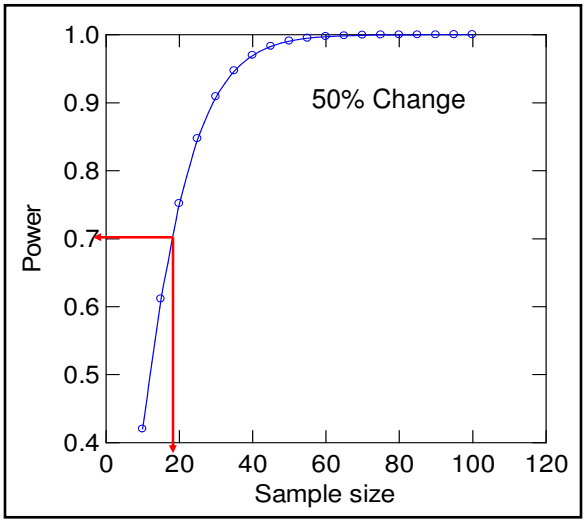


Shifting Scale

Natural variability (CV)

- Population
  - Adults **41%**
  - YOY **78 %**
- 50m habitat sections
  - Adults **74%**
  - YOY **131%**

- What does this mean for monitoring brook trout populations?

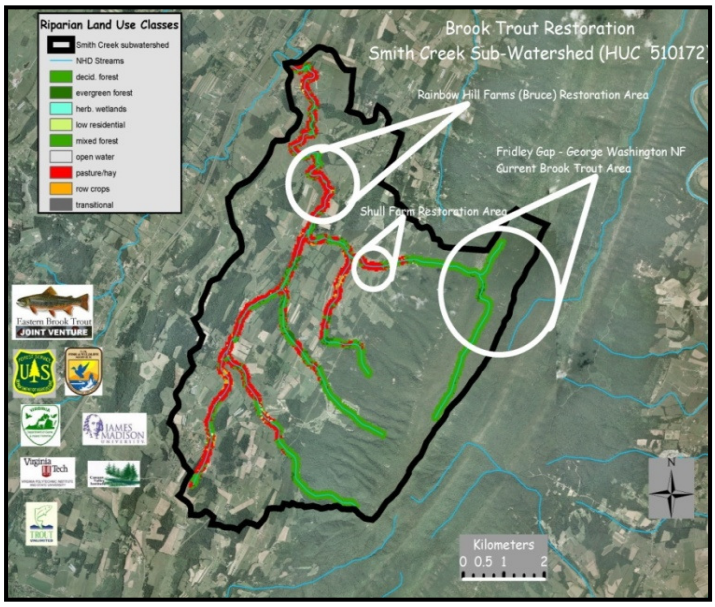


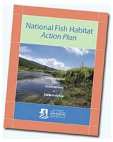
Fish Community Responses to the Addition of Wood in Smith Creek, VA

Fish & Aquatic Ecology Unit

Chas Kyger

Biology Department





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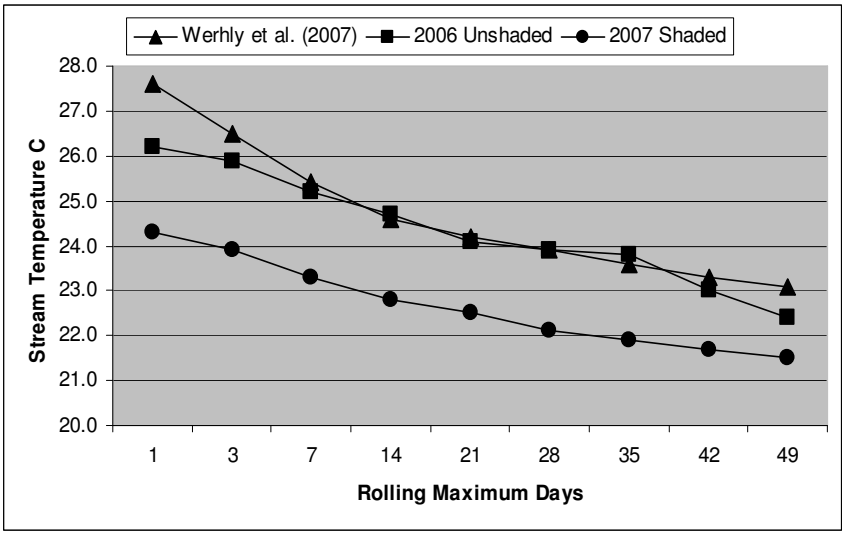
Smith Creek Restoration

- Fence out cattle
  - Decrease sediment and nutrients
  - Stabilize stream bank
  - Improve stream habitat
- Plant riparian trees
  - Increase shade to lower water temperature
  - Stabilize stream bank and reduce erosion
  - Improve stream physical habitat

Smith Creek Restoration

- Goal
  - Restore habitat to conditions suitable for the reintroduction of native Brook trout
- Objectives
  - Increase shade to reduce stream temperature
  - Reduce sediment and nutrient loading
  - Improve stream physical habitat features



Question

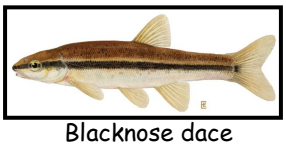
- How will the fish community respond to improvements in stream physical habitat, specifically, increases in the amount of large woody debris?

Question

- Looking ahead
  - When planted trees are large enough to contribute LWD to the stream how will the fish community respond?
  - Fish community response may be important to the ultimate goal of Brook trout re-introduction.

Smith Creek Fish Community

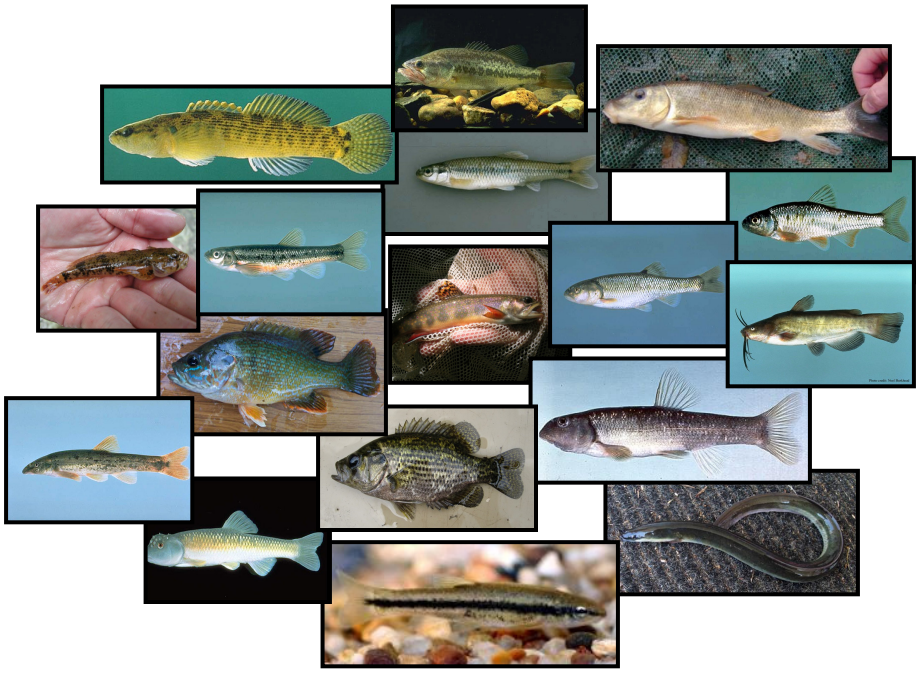
- 16 species
  - Dominated by Potomac sculpin, Fantail Darter, and Blacknose dace.
- Fish population estimates
  - Eighteen 30m sections
  - 3-pass depletion population estimate each July since 2005



Blacknose dace

Fantail darter

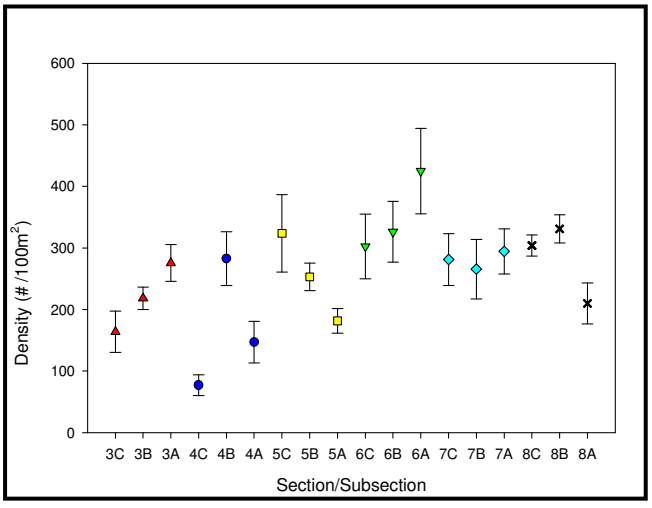
Potomac sculpin



Experimental Design

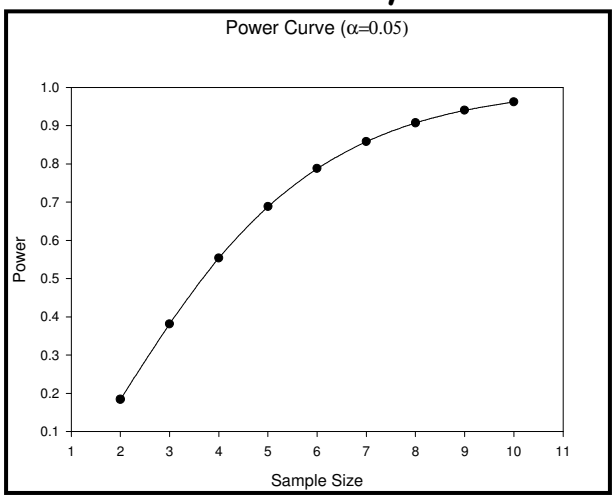
- BACI – Before-After Control-Impact
- Add wood to nine randomly selected 30m sections
- Nine 30m control sections
- Examine differences in fish community metrics:
  - Density
  - Species richness
  - Diversity
  - Size structure

Existing Data



Mean density of all fish (#/100m^2 ± SE) by 30 meter section in the Smith Creek Restoration Area. Samples are from electrofishing depletion estimates each July 2005-2008.

Power Analysis



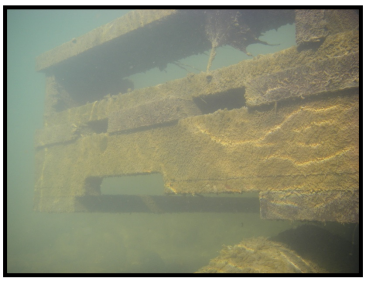
Power curve for an expected 25% increase in fish density

A sample size of 9 treatment sections achieves power > 0.9

Wood Addition

Pallets

- Why pallets?
  - Uniformity of treatment
  - Built to specification
  - Known surface area
  - Complex habitat



Wood Addition

- Comparing pallets to natural wood
  - Calculated loading density of wood from Fridley Run an upstream forested tributary

  - Convert loading density to surface area to come up with the number or pallets needed per 100m^2
  - 1 pallet ≈ 3m^2 surface area; ≈ 12 pallets per 100m^2

Objectives/Hypotheses

1. Determine if density (#/100m^2) of any fish species differs between treatment section that receive wood addition and control reaches that do not.
2. Determine if adding wood causes changes in species richness and diversity indices of the fish community.
3. Determine if adding wood effects the size structure of any fish species.